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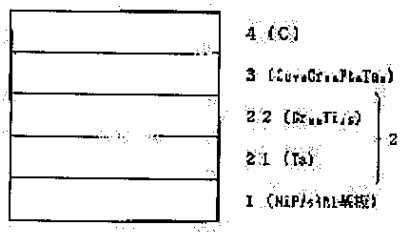
(54) MAGNETIC RECORDING MEDIUM AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a magnetic recording medium for a magnetic drum, a magnetic tape, magnetic disk, etc., which can reduce medium noise especially when recording or reproduction is made and a method for manufacturing the medium.
SOLUTION: A magnetic recording medium is constituted basically of a nonmagnetic substrate 1, a nonmagnetic base layer 2, a magnetic film 3, and a protector film 4 and the base film 2 is constituted by piling a second base film 22 made of Cr or a Cr alloy upon a first base film 21 made of an element selected from among Ta, Ag, and Al. The magnetic film 3 made of an alloy composed mainly of Co.



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CLAIMS

[Claim(s)]
[Claim 1] It is magnetic-recording data medium which is magnetic-recording data medium which considers a nonmagnetic substrate, a nonmagnetic substrate film, a magnetic film, and a protective coat as a basic configuration, and said nonmagnetic substrate film comes to carry out the laminating of the 2nd substrate film with which only Cr consists of Cr alloys on the 1st substrate film mainly constituted in an element chosen from Ta, Ag, and aluminum, and is characterized by for said magnetic film to be a film which consists of alloys which use Co as a principal component.
[Claim 2] The 1st substrate film is magnetic-recording data medium according to claim 1 characterized by being chosen out of a TaN alloy containing 1 - 50at% N, a TaSi alloy containing 5 - 40at% Si, and a TaMo alloy containing 5 - 50at% Mo.
[Claim 3] Magnetic-recording data medium according to claim 1 or 2 characterized by being aluminum substrate with which a nonmagnetic substrate plated NiP.
[Claim 4] Magnetic-recording data medium according to claim 1 or 2 characterized by a nonmagnetic substrate being a glass substrate.
[Claim 5] Magnetic-recording data medium according to claim 1 or 2 characterized by a nonmagnetic substrate being an Si substrate.
[Claim 6] Magnetic-recording data medium given in any 1 term of claims 1-5 characterized by the 1st substrate film being 25-1000A thickness.
[Claim 7] Magnetic-recording data medium given in any 1 term of claims 1-6 to which the 1st substrate film is formed with Ta alloy, and only alpha-Ta is characterized by forming alpha-Ta and beta-Ta.
[Claim 8] Magnetic-recording data medium given in any 1 term of claims 1-7 characterized by a magnetic film consisting of a 4 yuan alloy of CoCrPtTa.
[Claim 9] Magnetic-recording data medium given in any 1 term of claims 1-8 characterized by a residual magnetization thickness product (BrT) of a magnetic film being 50-130Gmum.
[Claim 10] A manufacture method of a film which consists of alloys which form the 2nd substrate film with which the 1st substrate film mainly constituted in an element first chosen from Ta, Ag, and aluminum as a nonmagnetic substrate film at least is formed, and only Cr consists of Cr alloys after that on a nonmagnetic substrate, and use Co as a principal component as a magnetic film, and magnetic-recording data medium characterized by carrying out sequential membrane formation of the protective coat further.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to magnetic-recording data medium which reduced the data-medium noise at the time of record playback, and its manufacture method about magnetic-recording data medium, such as a magnetic drum, a magnetic tape, and a magnetic disk.
[0002]
[Description of the Prior Art] In recent years, magnetic-recording data medium suitable for the magnetic head (henceforth an MR head) using a magneto-resistive effect with high playback sensitivity is needed with the raise in the recording density of a magnetic disk drive etc. The MR head has been a technical problem with the very important fall of a data-medium noise, in order to improve the signal-noise ratio (S/N) of the whole magnetic disk drive also in magnetic data medium, since the head noise is low compared with the conventional electromagnetic-induction mold arm head.
[0003] Moreover, by magnetic-recording data medium for MR heads, since low premature start height-ization of an arm head is required with improvement in recording density, compared with the former, high surface smooth nature is required of a substrate, and surface average-of-roughness-height Ra of a substrate is small. As a record medium for magnetic disks which used as the substrate current and aluminum alloy generally used, on said nonmagnetic substrate, Cr or Cr alloy was formed upwards as a nonmagnetic substrate film, the various proposals of what formed the CoCrTa alloy which uses Co as a principal component as a magnetic film are made, and it is put in practical use. For example, raising magnetic properties, especially coercive force is proposed by JP,1-232522,A by forming the alloy which added one or more sorts of metals among Cu, Nb, Ti, V, Zr, Mo, Zn, W, and Ta in Cr or Cr as a nonmagnetic substrate film. Moreover, improving properties, such as coercive force and S/N, is proposed by JP,8-3893,B by forming the substrate layer which consists of CrTi on a nonmagnetic substrate. Furthermore, the technique of carrying out [technique] precoat of the Cr to a glass substrate etc., forming [technique] Cr or Cr alloy on this film, and making the magnetic layer which consists of Co form on it further is also known.
[0004]
[Problem(s) to be Solved by the Invention] In said JP,1-232522,A, although Cr or Cr alloy was used as a nonmagnetic substrate film, it was that to which the effect of anisotropy control of the circumferencial direction of the disk by a texture ring etc. becomes weaker, coercive force falls to with smoothing of a substrate, and the output at the time of playback falls. Furthermore, in order to obtain a comparable output, when thickness of a magnetic layer was thickened, there was a problem that the noise at the time of record playback became high. moreover, by the method of using for a substrate layer, CrTi given in said JP,8-3893,B It devises so that it is not necessary to take out the tray section which conveys a disk into atmospheric air. When membranes are formed by "3100 Spatter amelioration type" by Anelva which was made to lessen effect of degasifying from the tray section at the time of membrane formation, Although Cr was formed on the substrate, the property improved more notably, as compared with what used CrTi for the substrate, in property, the difference was lost and especially the effect of CrTi was hardly seen. And neither of properties, such as a playback output and a noise, were satisfying enough things. If the value amended by analysis by SIMS by 31P reinforcement inside the NiP deposit of 16O of the interface of Cr alloy and Co alloy compares, "3100 Spatter" by Anelva will be [the direction of 0.20 and "3100 spatter amelioration type"] 0.11, and a difference will be looked at by the amount of oxygen of an interface. Furthermore, it was not what it can be satisfied with the technique of carrying out precoat of said Cr of enough although it is possible to be able to prevent degasifying from a glass substrate and for or to raise magnetic properties a little. In view of such a trouble, the purpose of this invention has a fully low noise at the time of record playback, and is to offer magnetic-recording data medium suitably combined with an MR head out of which a playback output comes highly enough.
[0005]
[Means for Solving the Problem] In order to make an output at the time of playback high, without making high a noise at the time of record playback, it is desirable to grow up Cr of a nonmagnetic substrate film or Cr alloy, and Co alloy on it epitaxial. In order to attain the aforementioned purpose, it is magnetic-recording data medium which considers a nonmagnetic substrate, a nonmagnetic substrate film, a magnetic film, and a protective coat as a basic configuration. Namely, said nonmagnetic substrate film Only Cr comes to carry out the laminating of the 2nd substrate film which consists of Cr alloys on the 1st substrate film which consists of elements chosen from Ta, Ag, and aluminum, and magnetic-recording data medium characterized by said magnetic film being a film which consists of alloys which use Co as a principal component, and its manufacture method are proposed.

[0006]
[Embodiment of the Invention] In addition to aluminum alloy (henceforth a NiP plating aluminum substrate) with which the NiP plating film generally used as a substrate for magnetic-recording data medium was formed as a nonmagnetic substrate in said this invention, a glass substrate, a silicon substrate, etc. which are excellent in surface smooth nature can be used. As mentioned above, by magnetic-recording data medium for MR heads, since low premature start height-ization of an arm head is required with improvement in recording density, compared with the former, high surface smooth nature is needed to a substrate. That is, as for the substrate used for this invention, it is desirable for surface average-of-roughness-height Ra to be 20A or less.
[0007] Moreover, the nonmagnetic substrate film in said this invention comes to carry out the laminating of the 2nd substrate film with which only Cr consists of Cr alloys on the 1st substrate film which consists of elements chosen from Ta, Ag, and aluminum. When said 1st substrate film is formed, the 2nd substrate film and Co alloy magnetic film which are formed on it are considered to carry out crystalline good epitaxial growth. As thickness of this 1st substrate film, 25-1000A is desirable. Since there is orientation for the crystalline good effect which carries out epitaxial growth to become inadequate in the 2nd substrate film and Co alloy magnetic film which carry out a laminating on it if the thickness of the 1st substrate film is thinner than 25A, the time amount which will form the 1st substrate film if thicker than 1000A becomes long and the throughput of the whole process becomes low, it is not desirable. Therefore, as for the thickness of the 1st substrate film, it is desirable that it is 25-1000A. In addition, what added one or more sorts of other elements in the range which does not spoil the effect which forms the 1st substrate film as this 1st substrate film in the element chosen from Ta, Ag, and aluminum may be used. If the 1st substrate film is constituted from an alloy chosen from the TaN alloy which contains 1 - 50at% N especially, the TaSi alloy containing 5 - 40at% Si, and the TaMo alloy containing 5 - 50at% Mo, that in which properties, such as coercive force, an output at the time of playback, and a noise, were further excellent will be obtained (henceforth the 2nd invention). In addition, although there were alpha-Ta, beta-Ta, etc. in Ta film and the TaN alloy film which are obtained by carrying out sputtering, or a TaMo alloy film, the satisfying property was not acquired, when membrane formation conditions were changed and only beta-Ta was formed. Moreover, although the method of carrying out sputtering of the Ta in the mixed-gas ambient atmosphere of Ar and nitrogen, the method of carrying out sputtering of the TaN alloy in Ar gas ambient atmosphere, etc. can be mentioned as the formation method of a TaN alloy film, what kind of method may be adopted. As thickness of said 2nd substrate film, 25-500A is desirable. If it is difficult to suppress the fall of coercive force Hc no matter what film [Cr alloy] it may use if the thickness of the 2nd substrate film is thinner than 25A and it is thicker than 500A, data-medium noise reduction-ization will become difficult by crystal grain child big and rough-ization of Co alloy magnetic film formed on it. Therefore, as for the thickness of the 2nd substrate film, it is desirable that it is 25-500A. In the 2nd invention which constituted the 1st substrate film from an alloy chosen from the TaN alloy which contains 1 - 50at% N as mentioned above, the TaSi alloy containing 5 - 40at% Si, and the TaMo alloy containing 5 - 50at% Mo, it is desirable to make the 2nd substrate film into 25-1500A for the same reason as the above. In addition, what was added one or more sorts in the range which does not spoil the effect which forms the 2nd substrate film for the element of Ti, Mo, aluminum, Ta, or others to Cr is sufficient as this 2nd substrate film.
[0008] Although the magnetic film in said this invention consists of alloys which use Co as a principal component, CoCrPt, CoCrPtTa, etc. containing Pt are used suitably. It is a time of using CoCrPtTa that especially the effect of a substrate shows up notably. In addition, when it takes into consideration that it is magnetic data medium for MR heads, as for the thickness of this magnetic film, it is desirable to adjust so that the residual magnetization thickness product BrT may serve as 50-130Gmum. If the residual magnetization thickness product BrT is less than 50Gmum, a suitable output will not be obtained, and if 130Gmum is exceeded, the property suitable for MR media cannot be acquired.
[0009] That what is necessary is not to limit especially about the other configurations or membrane formation methods etc., and just to adopt the thing of well-known configurations, such as carbon, as a protective coat, as the membrane formation method, although a spatter is usually used, vacuum evaporationo, ion plating, plating, etc. can also be used. Moreover, it is a book at least between said nonmagnetic substrate films and nonmagnetic substrates.
[0010] In this way, since magnetic-recording data medium of this invention produced is structure which carries out precoat of the 1st substrate film which consists of elements chosen from Ta, Ag, and aluminum as a nonmagnetic substrate film in advance of membrane formation of the 2nd substrate film which consists of Cr or a Cr alloy, properties, such as coercive force, an output at the time of playback, and a noise, are excellent. Moreover, in the 2nd invention which constitutes the 1st substrate film from an alloy chosen from the TaN alloy containing 1 - 50at% N, the TaSi alloy containing 5 - 40at% Si, and the TaMo alloy containing 5 - 50at% Mo, properties, such as coercive force, an output at the time of playback, and a noise, become what was further excellent.
[0011]
[Example] Hereafter, the example of this invention is shown. However, this invention is not limited to the following examples, and unless the configuration of a publication is changed into a claim, it can be carried out even to how.
[0012] It set to the inside made from Anelva "3100 spatters", after giving the texture ring of surface roughness Ra15A to a [example 1] NiP plating aluminum substrate. After forming 400A of Ta films as the 1st substrate film after exhausting to ultimate-vacuum 2x10-7Torr, and forming 200A of Cr85Ti15 alloy films as the 2nd substrate film, it is Co78Cr13Pt6Ta3 succeedingly. The alloy magnetic film was formed. Furthermore, on the magnetic film, 150A of carbon was formed as a protective coat. Ar pressure at the time of membrane formation was respectively set to 3mTorr(s). The thickness of a magnetic film was 110Gmum by the residual magnetization thickness product (BrT). In addition, the structure of obtained magnetic-recording data medium was typically shown in drawing 1 . For a nonmagnetic substrate film and 21, as for the 2nd substrate film and 3, the 1st substrate film and 22 are [one / a nonmagnetic substrate and 2 / a magnetic film and 4] protective

coats among drawing. Measuring the magnetic properties of magnetic-recording data medium produced by this example 1 using oscillating-type magnetic-properties equipment (VSM), 2563Oe(s) and the coercive force square shape ratio (S*) of coercive force (Hc) were 81.8%. The record reproducing characteristics of magnetic-recording data medium were measured in track-recording-density 148.5KFCI using the compound-die thin film magnetic head which has a magnetic-reluctance (MR) element in the playback section. The output at the time of record playback of magnetic-recording data medium of an example 1 was 196 microvolts, and the noise was 2.40 microvolts.

[0013] Using "3100 Spatter amelioration type" by [example 2] Anelva, a texture ring was not given to a NiP plating substrate, but magnetic-recording data medium was produced like said example 1 except having formed 300A of Cr80Ti20 alloy films as the 2nd substrate film further. Measuring like [reproducing characteristics / which were produced by this example 2 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2535Oe(s) and S*. 194 microvolts and the noise of the output were 2.33 microvolts 80.3%.

[0014] Using "3100 Spatter amelioration type" by [example 3] Anelva, a texture ring was not given to a NiP plating substrate, but magnetic-recording data medium was produced like said example 1 except having formed 300A of Cr films as the 2nd substrate film further. Measuring like [reproducing characteristics / which were produced by this example 3 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2496Oe(s) and S*. 190 microvolts and the noise of the output were 2.35 microvolts 80.1%.

[0015] Magnetic-recording data medium was produced like said example 1 except having not given a texture ring to a [example 1 of comparison] NiP plating substrate, and having not formed the 1st substrate film, but having formed 300A of Cr80Ti20 alloy films as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 1 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2157Oe(s) and S*. 155 microvolts and the noise of the output were 3.23 microvolts 70.8%.

[0016] Magnetic-recording data medium was produced like said example 1 except having not formed the 1st substrate film of [the example 2 of a comparison], but having formed 300A of Cr80Ti20 alloy films as the 2nd substrate film. Measuring like reproducing characteristics / which were produced by this example 2 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2357Oe(s) and S*. 180 microvolts and the noise of the output were 3.23 microvolts 82.8%.

[0017] Magnetic-recording data medium was produced like said example 1 except having not formed the 1st substrate film of [the example 3 of a comparison], but having formed 300A of Cr films as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 3 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2094Oe(s) and S*. 150 microvolts and the noise of the output were 3.96 microvolts 71.0%.

[0018] Magnetic-recording data medium was produced like said example 1 except having not formed the 1st substrate film but having formed 300A of Cr80Ti20 alloy films as the 2nd substrate film using "3100 Spatter amelioration type" by [example 4 of comparison] Anelva. Measuring like [reproducing characteristics / which were produced by this example 4 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2405Oe(s) and S*. 182 microvolts and the noise of the output were 3.02 microvolts 83.0%.

[0019] Magnetic-recording data medium was produced like said example 1 except having not formed the 1st substrate film but having formed 300A of Cr films as the 2nd substrate film using "3100 Spatter amelioration type" by [example 5 of comparison] Anelva. Measuring like [reproducing characteristics / which were produced by this example 5 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2360Oe(s) and S*. 178 microvolts and the noise of the output were 3.20 microvolts 81.2%.

[0020] Magnetic-recording data medium was produced like said example 1 except having not given a texture ring to a NiP plating substrate, but having formed 500A of Cr films as the 1st substrate film using "3100 Spatter amelioration type" by [example 6 of comparison] Anelva, and having formed 300A of Cr80Ti20 alloy films as the 2nd substrate film. Measuring like reproducing characteristics / which were produced by this example 6 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2119Oe(s) and S*. 158 microvolts and the noise of the output were 3.73 microvolts 72.8%.

[0021] "3100 spatter amelioration type" by [example 4] Anelva -- using -- a NiP plating substrate -- a texture ring -- not giving -- as the 1st substrate film -- Ta film -- as 600A and the 2nd substrate film -- Cr81Ti15Ta4 Magnetic-recording data medium was produced like said example 1 except having formed 300A of alloy films. Measuring like [reproducing characteristics / which were produced by this example 4 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2561Oe(s) and S*. 188 microvolts and the noise of the output were 2.39 microvolts 79.5%.

[0022] Using "3100 Spatter amelioration type" by [example 5] Anelva, a texture ring was not given to a NiP plating substrate, but magnetic-recording data medium was produced like said example 1 except having formed Ta film as the 1st substrate film, and having formed 200A of Cr85Mo15 alloy films as 400A and the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 5 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2794Oe(s) and S*. 201 microvolts and the noise of the output were 2.35 microvolts 82.3%.

[0023] "3100 spatter amelioration type" by [example 6] Anelva -- using -- a NiP plating substrate -- a texture ring -- not giving -- as the 1st substrate film -- Ag film -- as 100A and the 2nd substrate film -- Cr83Ti15Ag2 Magnetic-recording data medium was

produced like said example 1 except 300A having formed membranes. Measuring like [reproducing characteristics / which were produced by this example 6 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2534Oe(s) and S*. 183 microvolts and the noise of the output were 2.45 microvolts 78.9%.

[0024] "3100 spatter amelioration type" by [example 7] Anelva -- using -- a NiP plating substrate -- a texture ring -- not giving -- as the 1st substrate film -- aluminum -- as 200A and the 2nd substrate film -- Cr83Ti15aluminum2 Magnetic-recording data medium was produced like said example 1 except 300A having formed membranes. Measuring like [reproducing characteristics / which were produced by this example 7 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2520Oe(s) and S*. 185 microvolts and the noise of the output were 2.44 microvolts 81.1%.

[0025] Using "3100 Spatter amelioration type" by [example 7 of comparison] Anelva, a texture ring was not given to a NiP plating substrate, but magnetic-recording data medium was produced like said example 1 except having formed Ta as the 1st substrate film and having formed 2000A of Cr85Ti15 as 800A and the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 7 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2520Oe(s) and S*. 186 microvolts and the noise of the output were 3.95 microvolts 78.5%.

[0026] Using "3100 Spatter amelioration type" by [example 8] Anelva, the nonmagnetic substrate was used as the single crystal Si, and a texture ring was not given, but magnetic-recording data medium was produced like said example 1 except having formed 300A of Cr80Ti20 as the 2nd substrate film further. Measuring like [reproducing characteristics / which were produced by this example 8 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2450Oe(s) and S*. 190 microvolts and the noise of the output were 2.35 microvolts 79.6%.

[0027] Using "3100 Spatter amelioration type" by [example 9] Anelva, the nonmagnetic substrate was used as crystallization glass (product made from OHARA), and a texture ring was not given, but magnetic-recording data medium was produced like said example 1 except having formed 300A of Cr80Ti20 as the 2nd substrate film further. Measuring like [reproducing characteristics / which were produced by this example 9 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2780Oe(s) and S*. 202 microvolts and the noise of the output were 2.26 microvolts 80.3%.

[0028] Using "3100 Spatter amelioration type" by [example 8 of comparison] Anelva, the nonmagnetic substrate was used as crystallization glass (product made from OHARA), and a texture ring was not given, but magnetic-recording data medium was produced like said example 1 except having formed Cr as the 1st substrate film and having formed 300A of Cr80Ti20 as 500A and the 2nd substrate film further. Measuring like [reproducing characteristics / which were produced by this example 8 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 1, Hc is 2231Oe(s) and S*. 158 microvolts and the noise of the output were 3.53 microvolts 72.8%.

[0029] About the following examples 10-15 and examples 9-17 of a comparison, since it was a thing concerning said 2nd invention, it considered as the example of a comparison except what constitutes the 1st substrate film from an alloy chosen from the TaN alloy containing 1 - 50at% N, the TaSi alloy containing 5 - 40at% Si, and the TaMo alloy containing 5 - 50at% Mo. What followed, for example, formed Ta as the 1st substrate film was made into the example of a comparison.

After giving the texture ring of surface roughness Ra15A to a [example 10] NiP plating aluminum substrate, it set in DC magnetron sputtering equipment. After forming 400A of Ta90N10 alloy films and forming 200A of Cr films as the 2nd substrate film by forming Ta90N10 target in Ar gas ambient atmosphere as the 1st substrate film after exhausting to ultimate-vacuum 2x10-7Torr, it is Co78Cr13Pt6 Ta3 succeedingly. The alloy magnetic film was formed. Furthermore, on the magnetic film, 150A of carbon was formed as a protective coat. Ar pressure at the time of membrane formation was respectively set to 3mTorr(s). The thickness of a magnetic film was 110Gmum by the residual magnetization thickness product (BrT). Measuring the magnetic properties of magnetic-recording data medium produced by this example 10 using oscillating-type magnetic-properties equipment (VSM), 2693Oe(s) and the coercive force square shape ratio (S*) of coercive force (Hc) were 85.8%. The record reproducing characteristics of magnetic-recording data medium were measured in track-recording-density 148.5KFCI using the compound-die thin film magnetic head which has a magnetic-reluctance (MR) element in the playback section. The output at the time of record playback of magnetic-recording data medium of an example 10 was 230 microvolts, and the noise was 2.33 microvolts. In addition, when the X diffraction reinforcement of magnetic-recording data medium of the example 10 produced by doing in this way was measured, as shown in drawing 2 , alpha-Ta and beta-Ta were formed.

[0030] It is Ar+3%N2 about Ta target as the 1st substrate film of [an example 11]. Magnetic-recording data medium was produced like said example 10 by forming membranes in a gas mixture ambient atmosphere except having formed 400A of TaN alloy films. Measuring like [reproducing characteristics / which were produced by this example 11 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2850Oe(s) and S*. 233 microvolts and the noise of the output were 2.23 microvolts 86.4%. In addition, when the presentation of Ta alloy film was analyzed by EDX (energy dispersive X-ray analyzer), Ta85N15 was formed.

[0031] Magnetic-recording data medium was produced like said example 10 except having not given a texture ring to a [example 12] NiP plating substrate, but having formed 50A of Ta70N30 alloy films as the 1st substrate film, and having formed 300A of Cr80Ti15 alloy films as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 12 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2740Oe(s) and S*. 229 microvolts and the noise of the output were 2.33 microvolts 84.3%.

[0032] A texture ring was not given to a [example 13] NiP plating substrate, but magnetic-recording data medium was produced like said example 10 except having formed the Ta70Si30 alloy film as the 1st substrate film, and having formed 300A of Cr80Ti20 alloy films as 50A and the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 13 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2844Oe(s) and S*. 240 microvolts and the noise of the output were 2.06 microvolts 86.8%.
[0033] Magnetic-recording data medium was produced like said example 10 except having not given a texture ring to a [example 9 of comparison] NiP plating substrate, and having not formed the 1st substrate film, but having formed 300A of Cr80Ti20 as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 9 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2157Oe(s) and S*. 155 microvolts and the noise of the output were 3.23 microvolts 70.8%.
[0034] Magnetic-recording data medium was produced like said example 10 except having not given a texture ring to a [example 10 of comparison] NiP plating substrate, and having not formed the 1st substrate film, but having formed 300A of Cr(s) as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 10 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2094Oe(s) and S*. 150 microvolts and the noise of the output were 3.20 microvolts 71.0%.
[0035] Magnetic-recording data medium was produced like said example 10 except having not given a texture ring to a [example 11 of comparison] NiP plating substrate, but having formed 500A of Cr(s) as the 1st substrate film, and having formed 300A of Cr80Ti20 as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 11 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2119Oe(s) and S*. 158 microvolts and the noise of the output were 3.53 microvolts 72.8%.
[0036] Magnetic-recording data medium was produced like said example 10 except having not given a texture ring to a [example 12 of comparison] NiP plating substrate, but having formed 400A of Ta as the 1st substrate film, and having formed 200A of Cr85Ti15 as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 12 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2563Oe(s) and S*. 196 microvolts and the noise of the output were 2.40 microvolts 81.8%.
[0037] Magnetic-recording data medium was produced like said example 10 except having not given a texture ring to a [example 13 of comparison] NiP plating substrate, but having formed 400A of Ta45Ns55 as the 1st substrate film, and having formed 200A of Cr85Ti15 as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 13 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2141Oe(s) and S*. 177 microvolts and the noise of the output were 3.82 microvolts 78.3%.
[0038] Magnetic-recording data medium was produced like said example 10 except having not given a texture ring to a [example 14 of comparison] NiP plating substrate, but having formed 600A of Ta50Si50 as the 1st substrate film, and having formed 200A of Cr85Ti15 as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 14 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 1961Oe(s) and S*. 166 microvolts and the noise of the output were 4.30 microvolts 75.4%.
[0039] A texture ring was not given to a [example 15 of comparison] NiP plating substrate, but magnetic-recording data medium was produced like said example 10 except having formed Ta30Mo70 as the 1st substrate film, and having formed 200A of Cr85Ti15 as 400A and the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 15 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 1577Oe(s) and S*. 169 microvolts and the noise of the output were 2.93 microvolts 77.2%.
[0040] Magnetic-recording data medium was produced like said example 10 except having used the [example 14] nonmagnetic substrate as the single crystal Si. Measuring like [reproducing characteristics / which were produced by this example 14 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2672Oe(s) and S*. 211 microvolts and the noise of the output were 2.32 microvolts 84.0%.
[0041] Magnetic-recording data medium was produced like said example 10 except having made the [example 15] nonmagnetic substrate into glass ceramics (product made from OHARA). Measuring like [reproducing characteristics / which were produced by this example 15 / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2680Oe(s) and S*. 212 microvolts and the noise of the output were 2.11 microvolts 85.3%.
[0042] Magnetic-recording data medium was produced like said example 10 except having made the [example 16 of comparison] nonmagnetic substrate into glass ceramics (product made from OHARA), having formed 500A of Cr(s) as the 1st substrate film further, and having formed 300A of Cr80Ti20 as the 2nd substrate film. Measuring like [reproducing characteristics / which were produced by this example 16 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2231Oe(s) and S*. 158 microvolts and the noise of the output were 3.53 microvolts 72.8%.
[0043] After exhausting a [example 17 of comparison] NiP plating substrate to 2x10-7Torr, magnetic-recording data medium was produced like said example 10 except having formed 400A of Ta films by forming Ta target in Ar gas ambient atmosphere as the 1st substrate film. Measuring like [reproducing characteristics / which were produced by this example 17 of a comparison / of magnetic-recording data medium / the magnetic properties and record reproducing characteristics] said example 10, Hc is 2350Oe(s) and S*. 165 microvolts and the noise of the output were 3.53 microvolts 73.4%. In addition, when the X diffraction reinforcement of magnetic-recording data medium produced by doing in this way was measured, only beta-Ta was formed as

shown in drawing 3 .
[0044]
[Effect of the Invention] As explained above, magnetic-recording data medium of this invention can reduce a data-medium noise, and can be used as magnetic-recording data medium corresponding to an MR head by which high power is obtained. For example, as compared with the technique of using as a substrate film conventional Cr or conventional Cr alloy mentioned above, or the technique of carrying out precoat of the Cr, what this invention excelled in properties, such as an output and a noise, remarkably is obtained. Moreover, when thickness of the 2nd substrate film is made into 25-500A, especially low noise data medium is obtained. Furthermore, high coercive force-ization can be attained when the presentation of Co alloy magnetic film is used as the 4 yuan alloy of CoCrPtTa.
[0045] When the 1st substrate film is constituted from an alloy chosen from the TaN alloy which contains 1 - 50at% N especially, the TaSi alloy containing 5 - 40at% Si, and the TaMo alloy containing 5 - 50at% Mo, properties, such as coercive force, an output at the time of playback, and a noise, become what was further excellent. In this case, when thickness of the 2nd substrate film is made into 25-1500A, especially low noise data medium becomes a ****** thing.

[Translation done.]